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Prevalence of Lungworm Infection in Small Ruminants in and Around Jimma Town, Southwest Ethiopia

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Abstract: Coprological and postmortem examinations were carried out from October 2010 to March 2011 for identification of the lungworm species and determinant factors associated with lungworm infection in sheep and goats. The number of investigated animals were 420 (235 sheep and 185 goats) for coprology and 114 (66 sheep and 48 goats) for postmortem examination. Overall prevalence rates of 25.24% and 29.04% were found by coprological and postmortem examinations respectively. Higher prevalence was observed in goats (26.49%) than sheep (24.26%) but the difference was not statistically significant (P^2= 0.273, $p > 0.05$). There was no significant difference ($p > 0.05$) in prevalence between sheep and goats of different sexes and body conditions and under different management systems. A higher prevalence (33.91%) was observed in 6-12 months old animals while the lowest (19.05%) was observed in less than 6 months age. There was a statistically significant difference among the three age categories (P^2 = 6.675, $p < 0.05$). Identified species were *Dictyocaulusfilaria*, *Muelleriuscapillaris* and *Protostrongylusrufescens*with prevalences of 13 (11.4%), 10 (8.77%) and 10 (8.77%) respectively. There is high prevalence of lungworm infection in the study area warns stake holders should think for the proper control and prevention of lungworms like application of repeated de-worming. For researchers interested in the diagnosis of lungworms infections, it is better if they depend more on the postmortem examination than faecal examination to accurately rule out lungworms provided economically feasible results.

Key words: Lungworms % Jimma % Prevalence % Small Ruminants

INTRODUCTION

The small ruminant population of Ethiopia is estimated to be nearly 23 million goats and 23.62 million sheep [1]. Of the total sheep population, 75% are raised in highlands with altitudes above 1,500 meter above sea level. The rest, 25%, are reared in the lowlands. Small ruminants are important contributors to food production in Ethiopia, providing 33% of meat consumption and 14% of milk consumption. In the central highlands of Ethiopia where mixed crop livestock production system is practiced, small ruminants account for 40% of cash income and 19% of the house hold meat consumption [2]. Sheep and goats contribute a quarter of the domestic meat consumption; about half of the domestic wool requirement; 40% of fresh skins and 92% of the value of semi - proceed skin and hide export trade. It is estimated that 1, 078, 000 sheep and 1, 128, 000 goats are used in Ethiopia for domestic consumption annually. There is also a growing export market for sheep and goats meat in the Middle Eastern Gulf States and some African countries. At optimum off take rates, Ethiopia can export 700, 000 sheep and 2 million goats annually and at the same time supply, 1, 078, 000 sheep and 1, 128, 000 goats for the domestic market [3].

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Up to half of all sheep deaths and morbidity on farms in Ethiopian highlands are caused by pneumonia and endoparasites [4]. Endoparasites, including *Dictyocaulusfilaria*, are major causes of death and morbidity [4]. Prevention and control of these parasites are, therefore, critical to enhance the economic benefit from these species of livestock. However, the incidence of parasitic diseases including respiratory helminthosis varies greatly from place to place depending on the relative importance of factors [5]. Therefore, the objectives of the present study were to determine the prevalence of lungworm infection in small ruminants, identify some of the determinant risk factors involved in infection and identify the involved species.

MATERIALS AND METHODS

Study Area: The study was conducted in Jimma town, Southwestern part of Ethiopia. Located at 352 Km Southwest of Addis Ababa and latitude of about 7°13'-8°56' N and longitude of about 35°52'- 37°37' E and at an elevation ranging from 1,725 to 1,789 meter above sea level. The area receives a mean annual rainfall of about 1,530mm which comes from the long and short rainy seasons. The annual mean minimum and maximum temperatures are 14.4°C and 26.7°C respectively. The small ruminant populations in the area were3, 310 sheep and 1,846 goats [1].

Study Animals and Management: Small ruminants (Sheep and goats) in the study area were kept under extensive traditional management system. These animals were maintained in small house hold flocks of mixed age for subsistence and small scale private farms usually for sale. Very small number of sheep and goats were managed under semi- intensive production system.

Study Design and Sampling Method: A cross sectional study was used on small ruminants in order to assess the prevalence of lungworm infection. Study animals were selected based on simple random sampling technique.

For coprological examination, faecal samples were collected directly from the rectum, put in screw capped glass bottles, packed in an ice box from the field and transported to the laboratory. In the laboratory, fresh faeces were weighed and wrapped with gauze, fixed on to a string in a beaker filled with water. The Baermann apparatus was left for 24 hours. The larvae in the faeces migrate to the gauze and settle at the bottom of the glass. After siphoning off the supernatant, the sediment was examined under low power microscope according to Charles [6].

In the postmortem examination, lungs were palpated for the presence of nodules. In the occurrence of the nodules they were trimmed off and worms were extracted from the tissue by gentle compression of a small non-calcified nodules or part of large nodule between two glass slides and then draw the worm away from the tissue with a thumb forceps. To collect all worms, the nodules were soaked in a beaker containing water. The collected worms were then identified and recorded as stated by Radostits *et al*. [7]. Air passages were opened starting from the trachea down to the small bronchi with fine blunt pointed scissor to detect the presence of adult Dictyocaulidae.

During identification of the larvae, the presence of *Dictyocaulusfilaria* was confirmed by the finding of the first stage larvae (L_1), with an anterior knob and black granular intestinal inclusions as indicated in Dunn [8]. The larvae of *Protostrongylusrufescens* and *Muelleriuscapillaris* were differentiated by their characteristic features at the tip of their tail [9].

Sample Size Determination: Using 95% confidence interval, the sample size for this particular study was determined by the formula given by Thrusfield [10]. Since there was no similar work done in the area previously, expected prevalence was taken as 50%. So the sample size was 384. However, to increase the level of accuracy in determining the prevalence, the sample size has been increased to 420. A total of 114 animals (66 sheep and 48 goats) were also examined at postmortem examination to see adult parasites.

Data Management and Analysis: The data were first entered and managed in to Microsoft excel work sheet and analyzed using Statistical Package for Social Sciences (SPSS) software version 17. The significant difference between the prevalence of lungworm was determined using descriptive statistics; Chi-Square test (P^2) and $P < 0.05$ is considered as statistically significant.

RESULTS

Coproscopic Examination: Out of the total 420 collected faecal samples, 25.24% (106/420) were positive. Respective to species of lungworms among positive samples prevalence were 37.74% (40/106), 27.36% (29/106),

Table 1: Prevalence of small ruminant lungworm infections based on species, sex, age, body condition and management

Risk Factor	No of examined small ruminants	Positive (%)	P- Value	P^2-value
Species				
Ovine	235	57 (24.26 %)	p > 0.05	0.273
Caprine	185	49 (26.49%)		
Sex				
Female	169	43 (25.44%)	p > 0.005	0.006
Male	251	63 (25.09%)		
Age				
#= 6 months	63	12 (19.05%)	p < 0.05	6.675
6 - 12 months	115	39 (33.91%)		
> 12 months	242	55 (22.73%)		
Body condition				
Poor	152	39(25.66)	p > 0.05	0.425
Medium	123	33(26.83)		
Good	145	34(23.45)		
Management				
Extensive	321	87 (27.10%)	p > 0.05	2.509
Semi-intensive	99	19 (19.19%)		

23.58(25/106) and 11.32% (12/106) for *Dictyocaulusfilaria*, *Muelleriuscapillaris*, *Protostrongy lusrufescens* and mixed infections respectively. Concerning animal species, prevalence was 26.49% in goats and 24.26% in sheep.

Postmortem Examination: Out of the total slaughtered animals, 28.95% (33/114) were positive for lungworm infection. The prevalence of infection was higher in sheep (30.33%) than in goats (27.08%). However, there was no statistical significant difference between sheep and goats ($P^2 = 0.14$; $p > 0.05$).

Almost similar prevalence of lungworms were recorded in male and female animals with $P^2 = 0.006$ and $p > 0.05$. But the differences in prevalence of lungworm infection among age groups were found statistically significant with higher prevalence recorded in 6-12 months and the lowest was in less than or equal to six months old (Table 1). Highest prevalence (26.83%) was observed in medium body condition than poor and good body conditions but the difference was statistically insignificant ($P^2 = 0.425$; $p > 0.05$). Similarly, highest prevalence was observed in animals managed under extensive systems than in semi-intensive systems with no significant difference ($P^2 = 2.509$; $p > 0.05$). Identified larvae of lungworms during coprological examination were *Dictyocaulusfilaria, Muelleriuscapillaris* and *Protostrongy lusrufescens* with total prevalence 9.52%, 6.9%and5.95% respectively.

DISCUSSIONS

The overall prevalences of small ruminant lungworms recorded in the present study were 25.24% and 28.95% by coproscopic and postmortem examinations respectively. This level of prevalence is almost in agreement with previous study done by Mengestom [11] in Tigray (Atsbi), Brook *et al.* [12] in Assela and Tewodros[13]. In and around Bahir Dar who had reported 21.5%, 27.8% and 28.3% respectively. The present finding was found less as compared with the finding of Tigist [14] in North and South Gondar Zones and Netsanet [15] in Debrebirhan who had reported 39.6% and 73.25% respectively. The difference might be due to the topography of the area which harbor the intermediate hosts especially for lungworms with indirect life cycle and/or due to the difference in the study area which favors the survival of the larvae or it might be due to the difference in the methods employed in the detection and probably due to nutritional status of animals in the respective study areas which could influence the level of immunity.

High level of occurrence was observed in goats (26.49%) compared to sheep (24.26%). This was in agreement with Tewodros [13] who reported that goats were more susceptible to lungworm but it disagreed with the findings of Regassa*et al*. [16] who reported sheep (40.4%) were found affected more than goats (31.7%) from the northeast Ethiopia. This variation might be due to the difference in grazing behavior of these two species of ruminants. Goats appear to be more susceptible to helminth parasites than sheep as they appear to develop less immunity. Sheep predominantly graze and pick up more parasites so that they have higher acquired resistance than goats which mostly browse. Goats with their browsing behavior consume uncontaminated matter with parasite larvae, so being less exposed to infective

larvae and therefore might have lower acquired resistance than sheep [17,18]. In the present study, approximately equal prevalence of lungworm infection was observed in male (25.09%) and the female (25.44%) animals. This result agrees with the earlier study of Teffera [19] in Dessie and Kombolcha and Netsanet [15] in and around Debrebirhan who reported equal susceptibility to lungworm infection. However, the result was not agreed withTigist [14] in North and South Gondar Zones and Hubado [20] in Assela and its surroundings who reported higher prevalence in females.

Regarding age, higher prevalence of lungworm infection was observed in the groups of 6-12 months (33.91%) as compared to age groups of less than or equal 6 months (19.05%) and greater than 12 months (22.73%). The difference was statistically significant ($p < 0.05$). This might be associated with the infrequent grazing behavior of animals with less than 6 months age and the acquired resistance of adult animals when they are greater than 1 year. Accordingly, as the age of animals increases, susceptibility to lungworm infection decreases [21].

The commonness of lungworm infection on coprological examination was higher in medium body conditioned (26.83%) than those of good body conditioned (23.45%) and poor body conditioned (25.66%) animals. Animals of good body condition are more able to resist lungworm infection than others. The reason for this could be due to the fact that poorly nourished animals appear to be less competent in getting ride off infection although it is usual for well fed animals provided that the right environmental conditions are made available [22].

In the present study, the pervasiveness was compared between animals that were kept under extensive and semi - intensive management systems of production. The prevalence was higher in animals that were kept under extensive management system of production than the semi-intensive which was in agreement with Alemu *et al*. [5] and Tigist [14]. The reason for this could be the degree of pasture contamination in the extensive system of production increases the degree of exposure that could result in high prevalence [23].

Species of lungworms collected via coprological and postmortem examinations were identified and *Dictyocaulusfilaria* was the commonest from both types of examinations followed by *Muelleriuscapillaris* while *Protostrongylusrufescens* was detected the least (Table 2). This difference in the prevalence of the different species of lungworms might be associated with differences in their life cycles. *Dictyocaulusfilaria* has a direct life cycle; takes less time to reach the infective stage and the larvae appear in the faeces within five weeks after ingestion [23]. The transmission of *Protostrongylusrufescens* and *Muelleriuscapillaris*is complex involving host, parasite, intermediate host and appropriate environmental climatic conditions. Furthermore, development from first stage to infective stage larvae in the snail takes 12 to 14 days and the prepatent period can take 30 to 60 days. Therefore, the probability of infection, transmission and re-infection take longer time compared with *Dictyocaulusfilaria* which result in lower frequency of infection with these parasites [21]. Postmortem examination depicted higher (28.95%) prevalence than coprological examination (25.24%). This was in harmony with the work of Alemu *et al.* [5] who reported 66.3% and 53.6% and Tigist[14] who reported 46.98% and 39.6% in postmortem and coprological examinations respectively. This difference between coprological and postmortem examinations could be related to worm nodules of *Protostrongylidae*. In *Muelleriuscapillaris*, those larvae which reach the lungs of sheep remain in the parenchyma and become encysted in fibrous nodules and because such nodules might not contain adults of both sexes, fertile eggs could not deposited in the air passages. For this reason, the number of larvae in the faeces is often not indicative of

Table 2: The occurrence of lungworms species in sheep and goats by coprological and postmortem examinations

	Examined animals	*Dictyocaulusfilaria*	*Muelleriuscapillaris*	*Protostrongylusrufescens*	Mixed infection
Coprology					
Ovine	235	18 (7.66%)	19 (8.09%)	13 (5.53%)	7 (2.98%)
Caprine	185	22 (11.89%)	10 (5.41%)	12 (6.49%)	5 (2.7%)
Total	420	40 (9.52%)	29 (6.9%)	25 (5.95%)	12 (2.86%)
Postmortem					
Ovine	66	8 (12.12%)	7 (10.61%)	5 (7.58%)	
Caprine	48	5 (10.42%)	3 (6.25%)	5 (10.42%)	
Total	114	13 (11.4%)	10 (8.77%)	10 (8.77%)	

the degree of infestation; however, these nodules could be detected during postmortem examination [7]. Again as stated in Fraser [24], the prepatent, postpatent phase or hypobiosis might also affect the detection of larvae by faecal examination.

CONCLUSION

In this study, lungworm infection in small ruminants was25.24% and 29.04% as recorded by coprological and postmortem examinations, respectively. This might indicate that postmortem examination was more reliable than faecal examination. Different risk factors were found affecting the prevalence; species, age, sex and body condition were pertinent. *Dictyocaulusfilaria*, *Muelleriuscapillaris* and *Protostrongy lusrufescens* were the species of lungworms depicted in the study area and of these *Dictyocaulusfilaria* had the highest prevalent.

Recommendations: There is high prevalence of lungworm infection in the study area warns stake holders to think for the proper control and prevention of lungworms like application of repeated deworming. Sheep and goats should be kept separately. Farmers who keep small ruminants should be advised not to keep their animals in extensive management system of production and to give more emphasis to young animals, poor and medium body conditioned animals. For researchers interested in the diagnosis of lungworms infections, it is better if they depend more on the postmortem examination than faecal examination to accurately rule out lungworms infections.

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